Flight Guidance System Harmonization Working Group

Working Group Report

The Flight Guidance System Harmonization Working Group (FGSHWG) is providing its Report to the Transport Airplane and Engines Issue Group (TAEIG) in the format requested by the FAA Transport Directorate. The Group has retained the original directions and formatting as a means to check for accuracy and completeness. The Group found the need to provide additional information to TAEIG, the FAA and JAA. This information is provided as Appendices to the Report.

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Transport Airplane Directorate

WG Report Format

Harmonization and New Projects

1 - BACKGROUND:

- *This section "tells the story."*
- *It should include all the information necessary to provide context for the planned action. Only include information that is helpful in understanding the proposal -- no extraneous information (e.g., no "day-by-day" description of Working Group's activities).*
- *It should provide an answer for all of the following questions:*

a. SAFETY ISSUE ADDRESSED/STATEMENT OF THE PROBLEM

(1) What prompted this rulemaking activity (e.g., accident, accident investigation, NTSB recommendation, new technology, service history, etc.)? What focused our attention on the issue?

The Working Group was tasked by the Transport Airplane and Engine Issues Group of ARAC with the following Terms of Reference:

1) Address needed changes in requirements for automatic flight control and guidance functions (including speed/thrust control),

2) Address performance, safety, failure and envelope protection functions, warnings, and annunciations,

3) Review recommendations that stem from recent transport aviation events and relate to crew error, cockpit automation and in particular, automatic flight control/guidance, made by the NTSB, the FAA human factors team, and the JAA human factors steering group,

4) Make any proposed amendments to §25.1329/ 25.1335 and advisory materials that are needed to resolve these recommendations consistent with the entire body of proposed amendments.

Activity prompting this action includes:

- NTSB recommendations
- Recommendation contained in the Human Factors Team Report
- Various Airworthiness Directives
- The situation that existing Rule and Advisory Material does not address current technology and systems (e.g., Heads Up Display)
- Rules and Advisory Material are not harmonized

The following list provides the specific NTSB Safety Recommendations that were considered as part of the Working Group activities. Recommendations against currently certified airplanes in addition to recommendations for new certification projects were considered. Although the proposed regulations and advisory material would have no consequence against currently certified airplanes, the contributing effects of the accidents and incidents detailed in the following Safety Recommendations were considered when the proposed rule and advisory material were developed.

NTSB Safety Recommendation A-92-035: Revise Advisory Circular 25.1329-1A to add guidance regarding autopilot failures that can result in changes in attitude at rates that may be imperceptible to the flight crew and thus remain undetected until the airplane reaches significant attitude deviations.

NSTB Safety Recommendation A-98-098: Require all manufacturers of transport-category airplanes to incorporate logic into all new and existing transport-category airplanes that have autopilots installed to provide a cockpit aural warning to alert pilots when the airplane's bank and/or pitch exceeds the autopilot's maximum bank and/or pitch command limits.

NTSB Safety Recommendation A-99-041: Require that the MD-11 autopilot system be modified to prevent upsets from occurring when manual inputs to the flight controls are made.

NTSB Safety Recommendation A-99-042: Review the design of all transport-category airplane autopilot systems and require modifications to those determined to be capable of creating upsets when manual inputs to the flight controls are made.

NTSB Safety Recommendation A-99-043: Require all new transport-category airplane autopilot systems to be designed to prevent upsets when manual inputs to the flight controls are made.

Note: The proposed rule and accompanying advisory material may not have addressed the issue contained in the above Safety Recommendations with the exact technical solution recommended by the NTSB. However, it is felt that the ***intent*** of each Safety Recommendation has been addressed.)

The following is a list of airplane accidents and incidents that ***may*** have been mitigated or avoided if the airplanes involved had been certified using the proposed rule and accompanying Advisory Circular. It must be stressed, however, that this is a very subjective assessment. There are many factors that are involved in the entire chain of events that occurred in each accident or incident. The Working Group feels that *some* part of the chain of events for each of the accidents (A) and incidents (I) listed below is addressed by the proposed rule and AC. However, it cannot be stated unequivocally that any of these accidents/incidents would have been avoided had the proposed rule and AC been in effect.

(A)	Feb. 19, 1985	China Airlines Boeing 747SP, San Francisco, CA, USA
(I)	Feb. 11, 1991	Interflug Airbus A310, Moscow, Russia
(I)	Dec. 12, 1991	Evergreen International Airlines Boeing 747-100, Thunder Bay, Ontario, Canada
(A)	Jan. 20, 1992	Lufthansa Airbus A320 Strasbourg, France
(A)	April 26, 1994	China Airlines Airbus A300-600, Nagoya, Japan
(A)	Oct. 31, 1994	American Eagle ATR-72, Roselawn, IN, USA
(I)	June 13, 1996	American Airlines McDonnell Douglas MD-11, Westerly, RI, USA
(A)	Jan. 9, 1997	Comair Embraer EMB-120T, Monroe, MI, USA
(A)	June 8, 1997	Japan Airlines McDonnell Douglas MD-11, Nagoya, Japan
(A)	Sept. 14, 1999	Olympic Airways Dassault Mystere-Falcon 900, Bucharest, Romania
(I)	Oct. 9, 1999	Amway Corporation Dassault Mystere-Falcon 900, Grand Rapids, MI, USA

N*ote*: As this is a harmonized activity, both foreign and domestic manufacturers and operators have been included.

(2) What is the underlying safety issue to be addressed in this proposal?

The following safety issues are being addressed with the proposed revision to the rule and AC/ACJ:

- Insufficient crew awareness of FGS behavior and operation
- Hazardous autopilot disengage transients, including a manual pilot override of an engaged autopilot
- Flight guidance system mode confusion resulting in crew errors (e.g., altitude violation)

- History of lack of awareness of unusual/hazardous attitudes during FGS operations (accidents and incidents)
- History of lack of speed awareness (accidents and incidents)
- Operation in icing conditions (e.g., limits of autopilot authority)

(3) What is the underlying safety rationale for the requirement?

Revise Rule to address the items in (2) above for automatic control systems and guidance systems

(4) Why should the requirement exist?

Most, if not all, large modern transport-category airplanes have Flight Guidance Systems installed. This proposed requirement addresses the safety requirements for a Flight Guidance System.

In responding to the Terms of Reference (TOR), the Working Group decided that the current scope of §/JAR 25.1329 and §/JAR 25.1335 rules does not cover the work that was tasked, and that a more modern rule to address a broader set of functions encompassed by what is now called Flight Guidance System is necessary. This new rule would address the integration of new functionality and technology that is provided in current airplanes and much that is anticipated for future airplane installations.

The Working Group proposed to cancel the current §25.1335 Rule, "Flight Director Systems" and to rename the §25.1329 Rule from "Autopilot System" to "Flight Guidance System" in order to accomplish the tasks listed in the TOR.

b. CURRENT STANDARDS OR MEANS TO ADDRESS

(1) What are the current regulations relative to this subject? (Include both the FAR's and JAR's.)

FAR § 25.1329 Automatic pilot system.

(a) Each automatic pilot system must be approved and must be designed so that the automatic pilot can be quickly and positively disengaged by the pilots to prevent it from interfering with their control of the airplane.

(b) Unless there is automatic synchronization, each system must have a means to readily indicate to the pilot the alignment of the actuating device in relation to the control system it operates.

(c) Each manually operated control for the system must be readily accessible to the pilots.

(d) Quick release (emergency) controls must be on both control wheels, on the side of each wheel opposite the throttles.

(e) Attitude controls must operate in the plane and sense of motion specified in Sec. 25.777 (b) and Sec. 25.779(a) for cockpit controls. The direction of motion must be plainly indicated on, or adjacent to, each control.

(f) The system must be designed and adjusted so that, within the range of adjustment available to the human pilot, it cannot produce hazardous loads on the airplane, or create hazardous deviations in the flight path, under any condition of flight appropriate to its use either during normal operation, or in the event of a malfunction, assuming that corrective action begins within a reasonable period of time.

(g) If the automatic pilot integrates signals from auxiliary controls or furnishes signals for operation of other equipment, there must be positive interlocks and sequencing of engagement to prevent improper operation. Protection against adverse interaction of integrated components, resulting from a malfunction, is also required.

(h) If the automatic pilot system can be coupled to airborne navigation equipment, means must be provided to indicate to the flight crew the current mode of operation. Selector switch position is not acceptable as a means of indication.

Amdt. 25-46, Eff. 12/1/78

FAR § 25.1335 Flight director systems.

If a flight director system is installed, means must be provided to indicate to the flight crew its current mode of operation. Selector switch position is not acceptable as a means of indication.

Amdt. 25-41, Eff. 9/1/77

JAR 25.1329 Automatic Pilot System

Date: October 1, 2000

(See ACJ 25.1329.)

(a) Each automatic pilot system must be approved and must be designed so that the automatic pilot can be quickly and positively disengaged by the pilots to prevent it from interfering with their control of the aeroplane.

(b) Unless there is automatic synchronization, each system must have a means to readily indicate to the pilot the alignment of the actuating device in relation to the control system it operates.

(c) Each manually operated control for the system must be readily accessible to the pilots.

(d) Quick release (emergency) controls must be on both control wheels, on the side of each wheel opposite the throttles.

(e) Attitude controls must operate in the plane and sense of motion specified in JAR 25.777(b) and JAR 25.779(a) for cockpit controls. The direction of motion must be plainly indicated on, or adjacent to, each control.

(f) The system must be designed and adjusted so that, within the range of adjustment available to the human pilot, it cannot produce hazardous loads on the aeroplane, or create hazardous deviations in the flight path, under any condition of flight appropriate to its use, either during normal operation, or in the event of a malfunction, assuming that corrective action begins within a reasonable period of time.

(g) If the automatic pilot integrates signals from auxiliary controls or furnishes signals for operation of other equipment, there must be positive interlocks and sequencing of engagement to prevent improper operation. Protection against adverse interaction of integrated components, resulting from a malfunction, is also required.

(h) Means must be provided to indicate to the flight crew the current mode of operation and any modes armed by the pilot. Selector switch position is not acceptable as a means of indication.

(i) A warning must be provided to each pilot in the event of automatic or manual disengagement of the automatic pilot. (See JAR 25.1322 and its AMJ.)

JAR 25.1335 Flight Director Systems

Date: October 1, 2000

Means must be provided to indicate to the flight crew the current mode of operation and any modes armed by the pilot. Selector switch position is not acceptable as a means of indication.

(2) How have the regulations been applied? (What are the current means of compliance?) If there are differences between the FAR and JAR, what are they and how has each been applied? (Include a discussion of any advisory material that currently exists.)

Compliance with the 25.1329 rule has largely followed the advisory material found in FAA AC 25.1329-1A or in JAA Advisory Circular ACJ 25.1329. Advances in autopilot technology have outpaced both the FAA circa-1968 guidance and the more current JAA ACJ 25.1329 material. Autopilot related issue papers and interim policy guidance have been used to fill these gaps in the regulatory and acceptable means of compliance material.

The regulations are applied in certification and validation of products. As a consequence, the differences between the FAR and JAR have to be addressed by the applicant. As a result, the certification is typically done to the more stringent requirement. The current acceptable means of compliance in the US and Europe also have significant differences which affect the amount and type of compliance demonstration required.

(3) What has occurred since those regulations were adopted that has caused us to conclude that additional or revised regulations are necessary? Why are those regulations now inadequate?

The discussion above relating to accidents, incidents, NTSB recommendations, new technological advances and other safety issues provide the basis and rationale for this activity.

In addition, the Terms of Reference tasked the working group to address a number of factors and considerations that have not been previously addressed by prior certification programs and associated certification documents. The Working Group did include text from an FAA Issue Paper S-7 "Performance after Takeoff") in the advisory material that accompanies this proposed rule change. This Issue Paper has been applied to most certification programs since the early 1980's.

The JAA has issued several NPA's to amend their rule and advisory material to reflect changes in technology and safety issues. To support harmonization, the Working Group worked to reconcile these different documents.

2. DISCUSSION of PROPOSAL

- *This section explains:*
  - → *what the proposal would require,*
  - → *what effect we intend the requirement to have, and*
  - → *how the proposal addresses the problems identified in Background.*
- *Discuss each requirement separately. Where two or more requirements are very closely related, discuss them together.*
- *This section also should discuss alternatives considered and why each was rejected.*

a. SECTION-BY-SECTION DESCRIPTION OF PROPOSED ACTION

(1) What is the proposed action? Is the proposed action to introduce a new regulation, revise the existing regulation, or to take some other action?

The proposed actions are:

1) To replace current FAR/JAR 25.1329 and FAR/JAR 25.1335 with a new FAR/JAR 25.1329 titled, "Flight Guidance System."

2) To provide new advisory material [AC/ACJ] to provide acceptable means of complying with the new Rule.
3) To amend JAR-AWO to be consistent with the new JAR 25.1329 provisions (JAA action).
4) To cancel the FAA interim autopilot policy ANM-99-01.
5) To make additional recommendations for issues that are outside of the Working Group's Terms Of Reference, but that the Working Group felt were important to be addressed. Please see Appendix 1 to this Working Group Report for these recommendations.

(2) If regulatory action is proposed, what is the text of the proposed regulation?

Please refer to Appendix 2 to this Working Group Report for a graphical depiction of the tracing between the existing and proposed rules.

Note: If viewing a software version of this appendix, use the Microsoft Word toolbar to select VIEW – PAGE LAYOUT to view the accompanying graphics.)

§/JAR 25.1329 Flight Guidance System
[See AC/ACJ 25.1329]

(a) Quick disengagement controls for the autopilot and autothrust functions must be provided for each pilot. The autopilot quick disengagement controls must be located on both control wheels (or equivalent). The autothrust quick disengagement controls must be located on the thrust control levers. Quick disengagement controls must be readily accessible to each pilot while operating the control wheel (or equivalent) and thrust control levers.

(b) The effects of a failure of the system to disengage the autopilot or autothrust functions when manually commanded by the pilot must be assessed in accordance with the requirements of §/JAR25.1309.

(c) Engagement or switching of the flight guidance system, a mode, or a sensor must not produce a significant transient response affecting the control or flight path of the airplane.

(d) Under normal conditions, the disengagement of any automatic control functions of a flight guidance system must not produce any significant transient response affecting the control or flight path of the airplane, nor require a significant force to be applied by the pilot to maintain the desired flight path.

(e) Under other than normal conditions, transients affecting the control or flight path of the airplane resulting from the disengagement of any automatic control functions of a flight guidance system must not require exceptional piloting skill or strength to remain within, or recover to, the normal flight envelope.

(f) Command reference controls (e.g., heading select, vertical speed) must operate consistently with the criteria specified in §/JAR 25.777(b) and 25.779(a) for cockpit controls. The function and direction of motion of each control must be plainly indicated on, or adjacent to, each control if necessary to prevent inappropriate use or confusion.

(g) Under any condition of flight appropriate to its use, the Flight Guidance System must not:
- produce unacceptable loads on the airplane (in accordance with §/JAR 25.302), or
- create hazardous deviations in the flight path.

This applies to both fault-free operation and in the event of a malfunction, and assumes that the pilot begins corrective action within a reasonable period of time.

(h) When the flight guidance system is in use, a means must be provided to avoid excursions beyond an acceptable margin from the speed range of the normal flight envelope. If the aircraft experiences an

excursion outside this range, the flight guidance system must not provide guidance or control to an unsafe speed.

(i) The FGS functions, controls, indications, and alerts must be designed to minimize flight crew errors and confusion concerning the behavior and operation of the FGS. Means must be provided to indicate the current mode of operation, including any armed modes, transitions, and reversions. Selector switch position is not an acceptable means of indication. The controls and indications must be grouped and presented in a logical and consistent manner. The indications must be visible to each pilot under all expected lighting conditions.

(j) Following disengagement of the autopilot, a visual and aural warning must be provided to each pilot and be timely and distinct from all other cockpit warnings.

(k) Following disengagement of the autothrust function, a caution must be provided to each pilot.

(l) The autopilot must not create an unsafe condition when the flight crew applies an override force to the flight controls.

(m) During autothrust operation, it must be possible for the flight crew to move the thrust levers without requiring excessive force. The autothrust response to flight crew override must not create an unsafe condition.

(3) If this text changes current regulations, what change does it make? For each change:

- **What is the reason for the change?**
- **What is the effect of the change?**

The proposed change includes requirements for Flight Guidance Systems, which is defined to include automatic flight control systems (i.e., automatic pilots), automatic thrust control (i.e., automatic throttles), and flight guidance (i.e., flight directors). The current rule 25.1329 applies only to automatic pilots and the current rule 25.1335 applies only to flight directors. There are rules in Part 25, subpart E - Powerplant, which do deal with some aspects of the autothrust system. However, these rules do not cover the flight guidance aspects of autothrust. There is no current rule that directly addresses automatic thrust control. Flight Guidance Systems (automatic flight control, automatic thrust control and guidance) need to follow compatible principles for ensuring safe flight and for flight crew awareness.

Consistent with the above discussion, the Working Group proposes to change the title of the regulation to "Flight Guidance System" to reflect the inclusion of autopilot, autothrust and flight director in a single rule.

25.1329 (a) This sub-section combines some requirements from the current rule [sub-sections (a), (c) and (d)] regarding the quick disengagement controls. The first sentence requires the controls, as does the current sub-section 25.1329(a) for autopilot, but also for automatic thrust systems. The next sentence stipulates that the autopilot disengagement controls be on the control wheel (or equivalent) in keeping with the intent of sub-sections 25.1329(c) and (d). The third and fourth sentences adapt the current autopilot requirement for accessibility and location of the quick disengagement control to the autothrust system.

Rationale for the change: It seemed logical to combine the requirements for quick disengagement of automatic control systems into a single rule. The pilot may need to disengage the autothrust system, as well, during a high workload condition, when removing hands from the primary controls and throttle levers would hinder task performance.

25.1329 (b) This is a new statement addressing the effects of a failure to disengage the autopilot or autothrust functions.

Rationale for the change: The group considered fixed requirements for the probability of such failures, but decided that given the variety of installations and characteristics of airplane types, that a system safety analysis in accordance with 25.1309 is the best course. This statement requires that such an analysis be conducted.

25.1329 (c) Sub-sections (c), (d) and (e) are essentially new and they provide standards for transients for FGS engagement, switching, and normal and non-normal disengagements. The intent of the current 25.1329(b) requirement for automatic synchronization is related to the need to limit transients during engagement, disengagement and mode changes of the autopilot system.

Rationale for the changes: Transients can adversely affect continued safe flight and the ability of the flight crew to safely intervene. Normal (non-failure) characteristics should be very benign, while rare normal and non-normal (failure) characteristics need to be safe.

25.1329 (d) See text for 25.1329 (c) above.

25.1329 (e) See text for 25.1329 (c) above.

25.1329 (f) The new material is adapted from the requirement for attitude controls found in the current 25.1329(e), extending it to the design of all command reference controls. The objective is that the applicant follow the same criteria for plane and sense of motion and marking that is required for other flight controls by FAR sections 25.777 and 25.779. The new material is adapted from the requirement for attitude controls found in

Rationale for the change: The increasing variety of flight guidance systems can lead to non-intuitive designs that would promote flight crew error. Command reference controls for airspeed, vertical speed, flight path angle, heading, altitude and so on, are considered vulnerable to crew error if the plane sense of motion and control marking are not consistent.

25.1329 (g) This is the same requirement stated in the current 25.1329 (f).

25.1329 (h) This is a new requirement for speed protection.

Rationale for the change: During FGS operation, flight crew awareness of or attention to airspeed may not be sufficient to provide timely detection of unintended speed changes that compromise safety. Also, in certain conditions, the current modes of the autopilot and/or autothrust may not be designed to prevent speed excursions outside the normal range. The intent of the rule is for the FGS to provide a speed protection function for all operating modes, such that the airspeed can be safely maintained within an acceptable margin of the speed range of the normal flight envelope. This requirement is intended to avoid unwanted excursions by enhancing flight crew awareness and possibly by mode reversions of the automatic flight control or thrust control systems.

25.1329 (i) This paragraph expands on the current 25.1329 (h) requirement for mode indications by adding a statement of the safety objective to minimize crew errors and confusion. It also addresses logical grouping and presentation of the mode indications and controls for the sake of visibility from each pilot position and for flight crew awareness of active modes and mode changes. It also incorporates the existing 25.1335 provisions.

Rationale for the change: Studies have shown that the lack of sufficient flight crew awareness of modes, transitions and reversions is a key safety vulnerability. This paragraph provides the regulatory basis for several provisions of the proposed advisory circular related to enhanced flight crew awareness of flight guidance system active/armed modes, and changes in flight guidance system behavior which may otherwise be unanticipated by the flight crew.

25.1329 (j) This requirement for a visual and aural autopilot disengagement warning is adopted from the JAR 25.1329 (i) and does not exist in the current FAR.

Rationale for the change: The current JAR requirement is valid because disengagement of the autopilot, for whatever reason, necessitates immediate flight crew intervention to assume

manual control of the airplane. Likewise, the requirement that the aural warning be distinct from other cockpit warnings is meant to provide unequivocal awareness that the flight crew must assume manual control of the airplane.

25.1329 (k) This paragraph is a new requirement that provides requirement for an indication of autothrust disengagement.

Rationale for the change: The flight crew needs to be aware that the autothrust system has disengaged, so that they do not continue to expect the desired speed control to be provided. Normally, however, the autothrust disengagement would not require immediate thrust control changes by the flight crew. Hence, the less specific "indication" rather than "warning" is required.

25.1329 (l) This new paragraph requires that flight crew override of the autopilot must be safe.

Rationale for the change: Several accidents and incidents, some with serious injuries and some with fatalities, have occurred after flight crew override of the autopilot. Nevertheless, it is not advisable to prohibit flight crew override in all cases, because the override might be the last resort for the flight crew to regain control of the airplane in certain abnormal (i.e., failure) conditions.

25.1329 (m) This new paragraph requires that the flight crew be able to affect thrust changes without exerting excessive force to override the operating autothrust system or creating an unsafe condition.

Rationale for the change: There may be times when the flight crew needs to immediately change thrust without needing to disengage the autothrust system. There may be cases when the normal controls for disengaging the autothrust system have failed and the ability to override the autothrust system is the only means available to manually control thrust.

25.1335 Existing FAR section deleted. The existing requirement has been incorporated into proposed 25.1329 (i).

(4) If not answered already, how will the proposed action address (i.e., correct, eliminate) the underlying safety issue (identified previously)?

This question is addressed under the rationale for change.

(5) Why is the proposed action superior to the current regulations?

The rationale for each paragraph of the proposed rule answers this question. In summary, the proposed rule expands the scope of 25.1329 beyond autopilot systems to include guidance for manual control and autothrust. These functions are increasingly integrated into the same equipment and the fundamental principles for engagement, disengagement, flight crew awareness of changes in system operation, etc., apply to each of the functions in a similar manner. The NTSB has recommended changes for enhanced flight crew awareness of system operation and changes in airplane condition. Often, during FGS operation, the flight crew is insufficiently aware of changes in attitude, airspeed, trim and so forth that could adversely affect flight safety. This rule and accompanying advisory material would increase the level of safety through improved system indications, annunciations, and speed protection.

b. ALTERNATIVES CONSIDERED

(1) What actions did the working group consider other than the action proposed? Explain alternative ideas and dissenting opinions.

See b.(2) below.

(2) Why was each action rejected (e.g., cost/benefit? unacceptable decrease in the level of safety? lack of consensus? etc.)? Include the pros and cons associated with each alternative.

List of rejected actions:

- Envelop FAA and JAA requirements without adding new requirements.

  Pro: Enveloping the FAA and JAA rules (i.e., adopting the most rigorous requirements of each) would have been a much simpler rulemaking task and easier for industry to adjust to. It would at least have harmonized the requirements and simplified bilateral validation programs.

  Con: The current requirements are out-of-date. They do not adequately address safety issues related to current designs and the anticipated direction of future designs. Service history and studies gives evidence that previous assumptions about the effectiveness of flight crew awareness of the airplane during autopilot operation are out of date as well. Flight crew reliance on automated flight control systems has increased markedly since the current regulations were issued. The FAA Human Factors Team Report, numerous NTSB safety recommendations, and other information point out the need to enhance flight crew awareness of autopilot and guidance system operation. Newer designs enable functions that were not possible for automated systems when the current regulations were developed. The newer designs tend to be more complex from the crew's perspective, and vulnerable to flight crew confusion over mode behavior and transitions. Newer designs integrate the functions of many related systems and are far more complex. Standards cannot be effective if they simply address a particular avionics system, they need to address the functionality, regardless of which systems host the functionality. For reasons like these, the simple adoption of current requirements would not provide adequate safety standards.

- To define the scope of the rule to include all automatic control and guidance systems including FMS, yaw damping, integrated energy management, etc.

  Pro: A fully integrated system as described above would provide increased safety as a result of complex interactions between systems being transparent to the flight crew, and all Human-Man Interfaces (HMI) would be consistent between the various functions. All functionality would be totally integrated and would not (if designed correctly) ever result in a situation where the individual systems "expectations" conflicted with each other.

  Con: The activity was considered out of scope of the Group's term of reference, although such a system may be desirable for future development. Many of the functions listed are not considered part of a Flight Guidance System, and would therefore require coordination and buy-in from several other harmonization groups. This would jeopardize completion of the task within a reasonable timeframe. Additionally, the cost of such as system would most likely be prohibitive when applied to some of the smaller Part 25 category aircraft.

- To require full Flight Envelope Protection

  Pro: Enhanced safety in all flight phases and Flight Guidance System modes.

  Con: It was felt that the cost/benefit return is not sufficient, as the primary focus in accidents and incidents was speed, rather than full flight envelope. Therefore, it was felt that the most cost effective approach would be obtained by requiring speed protection only. Additionally, full Flight Envelope Protection is more of a function of design of the overall flight control system of the airplane, and not the

Flight Guidance System. It makes little sense to require full Flight Envelope Protection only with FGS operation and not require it for manual flight.

- To require that Speed Protection always involve some form of automatic autothrust wakeup

  Pro: Enhance safety by having low speed protection thrust control engage automatically, even if the autothrust system is not currently active.

  Con: Many aircraft are not equipped with an autothrust system, so those airplanes would not benefit from any regulation of this type. Additionally, many autothrust systems require that the autothrust system be manually armed by manipulating a switch before the automatic function is allowed to become active. This is a necessary safeguard in some systems to prevent inadvertent activation when it could be hazardous, e.g., on the ground. Therefore, those system designs which depend on the manually switch before the system may be activated would make the design of such a "wake up" feature very difficult and costly to implement. It was felt that the rule and guidance material that was decided upon adequately addresses low speed awareness and protection without requiring this feature.

Minority Opinions

The Working Group members feel that all possible diligence was used when considering alternatives and dissenting opinions. The Working Group was not able to satisfy every member's concerns during our deliberations. One Minority Opinions was placed on record and that opinion can be found in Appendix 3.

Note: This Minority Opinions is, for the most part, against the proposed advisory material and not the proposed rule.)

c. HARMONIZATION STATUS

(1) Is the proposed action the same for the FAA and the JAA?

For 25.1329, essentially the FAA and JAA actions are the same. Text for the rule and advisory material is intended to be identical, except possibly for differences in spelling. Recommendations for changes to All-Weather Operations criteria to be consistent with the new 25.1329 will result in different actions for FAA and JAA due to different document structures.

(2) If the proposed action differs for the JAA, explain the proposed JAA action.

Material recommended for inclusion in the FAA Flight Test Guide AC 25-7A will be placed in a new ACJ No. 2 to JAR 25.1329.

(3) If the proposed action differs for the JAA, explain why there is a difference between FAA and JAA proposed action (e.g., administrative differences in applicability between authorities).

The JAA has a different document structure. The JAA does not have an equivalent document to the FAA AC 25-7A, Flight Test Guide.

3. COSTS AND OTHER ISSUES THAT MUST BE CONSIDERED

The Working Group should answer these questions to the greatest extent possible. What information is supplied can be used in the economic evaluation that the FAA must accomplish for each regulation. The more quality information that is supplied, the quicker the evaluation can be completed.

The following list of contacts can be used by the FAA Economist to initiate a discussion on cost associated with rulemaking.

Company	Contact	Telephone	E-mail address
Airbus			
Boeing	Jim VandenBrook	(425) 266-5566	james.d.vandenbrook@boeing.com
Bombardier			
Embraer S.A.			
Honeywell	Chris Durkin	(913) 712-6013	chris.durkin@honeywell.com
Rockwell-Collins	Peter Lyons		pdlyons9@rockwellcollins.com

a. COSTS ASSOCIATED WITH THE PROPOSAL

(1) Who would be affected by the proposed change? How? (Identify the parties that would be materially affected by the rule change – airplane manufacturers, airplane operators, etc.)

Avionics manufacturers would incur the added expense and time of designing and developing systems with additional features that would meet new proposed regulations, e.g., high and low speed protection. Airplane manufacturers would be impacted as well. Operators could be impacted by additional training requirements and the need to update equipment and documentation.

The new rule will be automatically applied to new TC programs. There will be additional development costs incurred by both the avionics and airplane manufacturers to meet the new regulations. As the new requirements are known in advance, the new features can be incorporated as part of the basic design.

If the new rule is applied to STC programs which will update an existing, previously certified airplane and to amended TC programs in which the changes are "cut-in" to an existing production line, new functionality of the airplane could be required (e.g., speed protection) and therefore additional costs will be incurred. These additional costs will be dependent upon the configuration of the airplane being modified and functionality of the system that is required to be installed in that airplane. The STC/ATC applicant could incur costs to modify the airplane to add additional sensors, wiring, etc. There will be increased costs associated with increased cost of equipment, development and flight test, etc. Both the avionics vendor and the STC/ATC applicant will incur increased costs to cover extended development and certification of the modified airplane. The operator and airplane manufacturer could incur increased costs by the fact that, if part of a fleet is required to meet the latest regulations, the operator might elect to bring their entire fleet up to the latest standards for fleet commonality and training considerations.

(2) What is the cost impact of complying with the proposed regulation? Provide any information that will assist in estimating the costs (either positive or negative) of the proposed rule.
(For example:

- ***What are the differences (in general terms) between current practice and the actions required by the new rule?***
- ***If new tests or designs were required, how much time and costs would be associated with them?***

- ***If new equipment is required, what can be reported relative to purchase, installation, and maintenance costs?***
- ***In contrast, if the proposed rule relieves industry of testing or other costs, please provide any known estimate of costs.***
- ***What more-- or what <u>less</u> -- will affected parties have to do if this rule is issued?***

NOTE: "Cost" does not have to be stated in terms of dollars; it can be stated in terms of work-hours, downtime, etc. Include as much detail as possible.)

All quantitative values and qualitative statements are based on the "delta" costs that would be incurred if this new rule is enacted, above and beyond what is already required by the existing rule.

Because the costs associated with any program will depend greatly on what kind of program it is, the following breakdowns have been used.

a) New TC Program – New development program with no airplanes having been manufactured.
b) Amended TC Program – Development program with changes being "cut-in" in ongoing production line.
c) Existing airplanes modified via STC or ATC in which the new FAR 21.101 (Changed Product Rule) Applies.
d) Existing airplanes modified via STC or ATC in which the new FAR 21.101 (Changed Product Rule) Does NOT Apply.

Additionally, each category listed above is broken down by technical subject for clarity.

a. <u>New TC Program – New development program with no airplanes having been manufactured</u>:

All new TC programs will be required to comply to the proposed revision to FAR 25.1329 when it takes effect. The costs associated with a new development program (e.g., design, testing, manufacture, training, etc.) which comply with the proposed revision to the regulations will not be, for the most part, significantly different than complying with the existing regulations. There are several possible exceptions, which are discussed individually below. All other aspects of the proposed regulations are either very similar to the existing regulations, or put into a regulatory basis that which should be considered as a "best design practice", such that no additional costs are incurred by compliance to the proposed regulation.

<u>Autopilot Override</u>

The proposed FAR 25.1329 (d) states:

> "Under normal conditions, the disengagement of any automatic control functions of a flight guidance system must not produce any significant transient response affecting the control or flight path of the airplane, nor require a significant force to be applied by the pilot to maintain the desired flight path."

Also, proposed FAR 25.1329 (l) states:

> "The autopilot must not create an unsafe condition when the flight crew applies an override force to the flight controls."

The proposed Advisory Material AC/ACJ 25.1329 that accompanies this revised regulation indicates that *one possible method of compliance* for the above paragraphs could be that any automatic horizontal trim be inhibited from moving, or should not be allowed to continue to move, when a pilot applies a force to the control column without first disengaging the autopilot. Many current designs are normally based on the assumption that the pilot will always disengage the autopilot before attempting manual control, and therefore, the horizontal trim system is not inhibited.

If this method of compliance described above is chosen by industry as the best method for compliance, then it could mean (depending on the flight control system design of the particular airplane in question) that installation

of a force sensor(s) on the control column is needed. There would be costs associated with this new installation, such as the cost of the transducer(s) itself, the mechanical interface to the control column mechanism, the electrical wiring associated with the transducer(s), the new interface to the autopilot by these new sensor(s), and additional autopilot design and testing of this new feature. There would be non-recurring costs associated with the design and testing, as well as a recurring cost per airplane for the additional hardware this feature would require.

Estimated Non-Recurring Design, Development, and Testing Costs associated with new force transducer(s):

Specific Data

GAMA — In first application of technology in type of airplane (i.e. hydraulic controls, cable controls, fly-by-wire controls): $200K
Estimated Non-Recurring Design, Development, and Testing Costs associated with new force transducer(s) in subsequent application of technology in type of airplane: $120K

Company #2

Company #3

Estimated Recurring Hardware and Manufacturing Costs (per airplane) associated with new force transducer(s):

Specific Data

GAMA — $12K

Company #2

Company #3

Estimated Crew Training and Operational Costs: TBD. However, as this is a new TC program which will require new crew training for all flight crews (unless it is a "common type rating" with another existing airplane model), it is felt that the training costs associated with this item will be minimal, if not zero.

Specific Data

GAMA — None

Company #2

Company #3

Pilot Awareness Flight Deck Annunciation

The proposed FAR 25.1329 (i) states:

> "The FGS functions, controls, indications, and alerts must be designed to minimize flight crew errors and confusion concerning the behavior and operation of the FGS. Means must be provided to indicate the current mode of operation, including any armed modes, transitions, and reversions. Selector switch position is not an acceptable means of indication. The controls and indications must be grouped and presented in a logical and consistent manner. The indications must be visible to each pilot under all expected lighting conditions."

The proposed Advisory Material that accompanies this revised regulation states that one method of compliance is to include an additional alert(s) in the flight deck to ensure pilot awareness of an unusual operating condition which may be masked by the use of the autopilot. This alert(s) would annunciate conditions such as when the autopilot is holding a significant and sustained out of trim command (which would indicate a condition for which the autopilot is compensating, such as icing, fuel imbalance, or an engine failure), or if the airplane is in an unusual bank or pitch attitude beyond those meant for autopilot operations.

If this is determined by industry as the best means of compliance to the revised regulations, there would be the costs associated design, development, and testing of this new alert(s).

Estimated Non-Recurring Design, Development, and Testing Costs associated with new flight deck alert(s):

Specific Data

GAMA	In first application of technology in type of airplane: $120K Estimated Non-Recurring Design, Development, and Testing Costs associated with subsequent application of technology in type of airplane: $59K
Company #2	
Company #3	

Estimated Recurring Hardware and Manufacturing Costs (per airplane) associated with new flight deck alert(s): *Minimal. Most, if not all, newly designed airplanes are equipped with "glass cockpits" that do not rely on discrete indicators and wiring, the costs associated with the hardware and manufacture of this new alert(s) are assumed to be minimal. The existing functionality of the flight deck will most likely support addition of a new alert without the need for more hardware and/or wiring. Therefore, any recurring costs should only be associated with the increased costs of the autopilot system itself, and those costs are felt to be minimal when compared to the entire cost of the system for a new TC program.*

Specific Data

GAMA	Minimal
Company #2	
Company #3	

Estimated Crew Training and Operational Costs: *TBD. However, as this is a new TC program which will require new crew training for all flight crews (unless it is a "common type rating" with another existing airplane model), it is felt that the training costs associated with this item will be minimal, if not zero.*

Specific Data

GAMA	Minimal
Company #2	
Company #3	

Speed Protection

The proposed FAR 25.1329 (h) states:

> "When the flight guidance system is in use, a means must be provided to avoid excursions beyond an acceptable margin from the speed range of the normal flight envelope. If the aircraft experiences an excursion outside this range, the flight guidance system must not provide guidance or control to an unsafe speed."

Although several current generation autopilot designs installed on transport-category airplanes include speed protection, the majority does not. Therefore, a good assumption would be that all new TC programs for airplanes smaller than 150 seats would be impacted by this rule. (Assumption: Due to competitive reasons, all new large transport-category airplanes will be equipped with an autopilot which will most likely include a speed protection feature, regardless of whether that feature is mandated by a regulation. The manufacturers of smaller Part 25 airplanes, and especially those airplanes which are not fully fly-by wire, would probably not choose to implement a speed protection feature voluntarily due to costs.)

The costs associated with speed protection will primarily be of the non-recurring variety. The design of such a feature will use existing interfaces from the autopilot to the flight control system, and from the autothrottle to the propulsion system. New display functionality will be required to annunciate when speed protection is active. However, that can most likely easily be accommodated with the current "glass cockpit" designs without additional hardware. Therefore, the recurring costs for this feature should be minimal.

Estimated Non-Recurring Design, Development, and Testing Costs associated with Speed Protection:

Specific Data

GAMA	in first application of technology in type of airplane: $210K Estimated Non-Recurring Design, Development, and Testing Costs associated with Speed Protection in subsequent application of technology in type of airplane: $120K
Company #2	
Company #3	

Estimated Recurring Hardware and Manufacturing Costs (per airplane) associated with Speed Protection: Minimal. It is felt that implementation of this system will most likely be handled internally to the autopilot system, and no new hardware or changes to other systems will be necessary. Therefore, any recurring costs should only be associated with the increased costs of the autopilot system itself, and those costs are felt to be minimal when compared to the entire cost of the system for a new TC program.

Specific Data

GAMA	$40K
Company #2	
Company #3	

Estimated Crew Training and Operational Costs: TBD. However, as this is a new TC program which will require new crew training for all flight crews (unless it is a "common type rating" with another existing airplane model), it is felt that the training costs associated with this item will be minimal, if not zero.

Specific Data

Company #1 Minimal

Company #2

Company #3

b. Amended TC Program – Development program with changes being "cut-in" in ongoing production line:

Please refer to 1) above for description of each technical category listed below.

It is assumed that the autopilot system can be updated without requiring major changes to other existing systems, such as requiring installation of a glass cockpit instead of more conventional mechanical flight deck instruments. If systems which interface with the autopilot system are required to change because of this rule, such as the display system requiring an update to support new flight deck annunciation, those costs are included in both the recurring and non-recurring costs shown above in 1).

Autopilot Override

All manufacturing recurring and non-recurring costs associated with this change in 1) above would also apply to 2). Additionally, costs would be incurred by the manufacturer for changes, updates, revisions, etc. to the manufacturing and installation processes, engineering documentation, tooling, and functional testing. Also, the operator would incur some expense for additional/updated crew training.

Estimated costs due to updated/revised manufacturing and installation processes, engineering documentation, tooling, and functional testing:

Specific Data

Company #1

Company #2

Company #3

Estimated Crew Training and Operational Costs:

Specific Data

Company #1

Company #2

Company #3

Pilot Awareness Flight Deck Annunciation

All manufacturing recurring and non-recurring costs associated with this change in 1) above would also apply to 2). Additionally, costs would be incurred by the manufacturer for changes, updates, revisions, etc. to the manufacturing and installation processes, engineering documentation, tooling, and functional testing. Also, the operator would incur some expense for additional/updated crew training.

Estimated costs due to updated/revised manufacturing and installation processes, engineering documentation, tooling, and functional testing:

Specific Data

Company #1

Company #2

Company #3

Estimated Crew Training and Operational Costs:

Specific Data

Company #1

Company #2

Company #3

Speed Protection

All manufacturing recurring and non-recurring costs associated with this change in 1) above would also apply to 2). Additionally, costs would be incurred by the manufacturer for changes, updates, revisions, etc. to the manufacturing and installation processes, engineering documentation, tooling, and functional testing. Also, the operator would incur some expense for additional/updated crew training.

Estimated Recurring Hardware and Installation Costs (per airplane) associated with Speed Protection: Minimal. It is assumed that this change can be made to existing airplanes by installation of a new autopilot(s) without any other new/revised hardware or wiring required. Therefore, the only recurring costs associated with this change would be the additional cost of the modified autopilot system itself. For those airplanes which are not equipped with Angle of Attack (AOA) sensors, it is assumed that the system will be designed such that it provides the best functionality it can given those limitations, but installation of AOA sensors to support this functionality will not be required.

Specific Data

Company #1

Company #2

Company #3

Estimated costs due to updated/revised manufacturing and installation processes, engineering documentation, tooling, and functional testing:

Specific Data

Company #1

Company #2

Company #3

Estimated Crew Training and Operational Costs:

Specific Data

Company #1

Company #2

Company #3

Dedicated Autoflight System Flight Testing in Icing Conditions

Dedicated autopilot testing, either in real icing conditions or with simulated ice shapes on the wing, may be required to certify a new autoflight system for use in icing conditions on an existing airplane. It cannot be stated conclusively, either one way or the other, that this testing will definitely be required. All that can be said is that it *may* be required. If this dedicated testing *is* required, however, it is felt by most that this will be a substantial economic impact to the applicant.

Estimated dedicated autopilot testing in icing conditions, including flight time (airplane and crew), any instrumentation necessary, engineering analysis and documentation of test results, etc.:

Specific Data

Company #1

Company #2

Company #3

c. Existing airplanes modified via STC or ATC in which the new FAR 21.101 (Changed Product Rule) Applies:

All new STC or ATC programs will be begin with the "default" position of being required to comply to the proposed revision to FAR 25.1329 (when it is accepted and published). In order to request the Certifying Authorities for a change from this default position to an earlier (most likely the original) certification basis, an assessment of whether the change to be made to the airplane is considered to be "Significant" or "Not Significant", per FAR 21.101 and AC 21.101-1A. If the change is deemed to be Significant, then this section applies. If the change is deemed to be Not Significant, then see section 4) below.

Given a change is Significant, the costs associated with a program of this nature are very much dependent upon both the airplane itself and the autoflight system which is to be installed. The costs (in general) are similar to those described above for a new TC program. Specific costs, such as numbers for the installation of force transducers on the control column, will be different, as new production recurring costs will be different than retrofit costs (which are generally higher).

It is assumed that the autopilot system can be updated without requiring major changes to other existing systems, such as requiring installation of a glass cockpit instead of more conventional mechanical flight deck instruments. If systems which interface with the autopilot system are required to change because of this rule, such as the display system requiring an update to support new flight deck annunciation, those costs are included below in both the recurring and non-recurring costs.

Specific Data

GAMA — Some costs, however, such as for tests with icing shapes or in natural icing, will be higher (these type tests are often part of a new TC program, but they are not normally part of an FGS retrofit program).

Company #2

Company #3

Autopilot Override

The same stipulation applies here as in 1) above, that the use of a force transducer(s) is deemed by the applicant as the best method of compliance to the new rule.

Estimated Non-Recurring Design, Development, and Testing Costs associated with new force transducer(s):

Specific Data

GAMA — In first application of technology in type of airplane (i.e. hydraulic controls, cable controls, fly-by-wire controls): $200K
Estimated Non-Recurring Design, Development, and Testing Costs associated with new force transducer(s) in subsequent application of technology in type of airplane: $120K

Company #2

Company #3

Estimated Recurring Hardware and Installation (including airplane downtime) Costs (per airplane) associated with new force transducer(s):

Specific Data

GAMA — $18K

Company #2

Company #3

Estimated Crew Training and Operational Costs:

Specific Data

GAMA — None

Company #2

Company #3

Pilot Awareness Flight Deck Annunciation

Estimated Non-Recurring Design, Development, and Testing Costs associated with new flight deck alert(s):

Specific Data

GAMA In first application of technology in type of airplane: $120K
Estimated Non-Recurring Design, Development, and Testing Costs associated with subsequent application of technology in type of airplane: $59K

Company #2

Company #3

Estimated Recurring Hardware and Installation (including airplane downtime) Costs (per airplane) associated with new flight deck alert(s): *TBD. This item will depend heavily if it is being installed on a conventional flight deck which uses mechanical indicators and discrete lights for warnings, or if the airplane being modified is equipped with a modern "glass cockpit".*

Specific Data

GAMA Minimal

Company #2

Company #3

Estimated Crew Training and Operational Costs:

Specific Data

GAMA Minimal

Company #2

Company #3

Speed Protection

Estimated Non-Recurring Design, Development, and Testing Costs associated with Speed Protection:

Specific Data

GAMA In first application of technology in type of airplane: $210K
Estimated Non-Recurring Design, Development, and Testing Costs associated with Speed Protection in subsequent application of technology in type of airplane: $120K

Company #2

Company #3

Estimated Recurring Hardware and Installation (including airplane downtime) Costs (per airplane) associated with Speed Protection: Minimal. It is assumed that this change can be made to existing airplanes by installation of a new autopilot(s) without any other new/revised hardware or wiring required. Therefore, the only recurring

costs associated with this change would be the additional cost of the modified autopilot system itself. For those airplanes which are not equipped with Angle of Attack (AOA) sensors, it is assumed that the system will be designed such that it provides the best protection it can, given those limitations, but installation of AOA sensors to support this functionality will not be required.

Specific Data

GAMA $40K

Company #2

Company #3

Estimated Crew Training and Operational Costs:

Specific Data

GAMA Minimal

Company #2

Company #3

Dedicated Autoflight System Flight Testing in Icing Conditions

Dedicated autopilot testing, either in real icing conditions or with simulated ice shapes on the wing, may be required to certify a new autoflight system on an existing airplane. It cannot be stated conclusively, either one way or the other, that this testing will definitely be required. All that can be said is that it *may* be required. If this dedicated testing *is* required, however, it is felt by most that this will be a substantial economic impact to the applicant.

Estimated dedicated autopilot testing in icing conditions, including flight time (airplane and crew), any instrumentation necessary, engineering analysis and documentation of test results, etc.:

Specific Data

GAMA It is anticipated that the preamble to the rule will contain the language as discussed in the plenary to meeting #15 of FGSHWG:

For amended TC and STC projects (e.g. where an existing, approved autopilot is replaced by another autopilot), a review of field history data may be conducted to assist in determining the extent of flight testing that is required. Where there is a lack of autopilot-related accidents and/or incidents in the icing environment, consideration should be given to showing compliance without the need for additional flight tests with ice shapes or in natural icing.

If it is determined during compliance plan negotiations with the Authority that testing of the FGS with ice shapes or in natural icing is NOT required, and compliance is shown through analysis of field history data, then the following additional costs will be incurred:

Estimated Non-Recurring field history analysis costs associated with showing compliance to the new icing environment assessment: $10K

Company #2

Company #3

Estimated Crew Training and Operational Costs: Minimal

Specific Data

GAMA — If it is determined during compliance plan negotiations with the Authority that testing of the FGS with ice shapes or in natural icing IS required, then the following additional costs will be incurred:

Estimated Non-Recurring Design, Development, and Testing Costs associated with icing environment tests: $270K

Estimated Recurring Hardware and Installation costs (per airplane) associated with autopilot flight tests in the icing environment: Minimal

Estimated Crew Training and Operational Costs: Minimal

Company #2

Company #3

d. Existing airplanes modified via STC or ATC in which the new FAR 21.101 (Changed Product Rule) Does NOT Apply:

Refer to the discussion above for applicability of the Changed Product Rule to a program involving an autoflight system change or addition. A change that could be considered to be Not Significant would be a replacement of one autoflight system (such as an analog system with individual hardware elements) with another autoflight system (such as an integrated digital system) of exactly the same capabilities and functionality. Per AC 21.101-1A, this change could considered to be Not Significant and therefore not be subject to the proposed regulations.

No "delta" costs are associated with a program of this type.

Specific Data

GAMA — Minimal

Company #2

Company #3

b. OTHER ISSUES

(1) Will small businesses be affected? ***(In general terms, "small businesses" are those employing 1,500 people or less. This question relates to the Regulatory Flexibility Act of 1980 and the Small Business Regulatory Enforcement Fairness Act of 1996.)***

Possibly. A small business, either an airplane owner and/or an STC applicant, could desire to install an autopilot in a previously certified Part 25 airplane and that change is deemed Significant under the Changed Product Rule (21.101). Therefore, that changed product would then be required to meet the new (proposed) 25.1329 rules, rather than the ones that were in place for the original certification. This could result in design changes to the system and airplane that would not have been required otherwise. However, it is felt that scenarios of this type will not often occur that would involve a small business.

Part 25 OEM's are typically not small businesses, and therefore there are not any small business manufacturers (i.e., new type certification programs) that will be affected.

(2) Will the proposed rule require affected parties to do any new or additional recordkeeping? If so, explain. ***[This question relates to the Paperwork Reduction Act of 1995.]***

No.

(3) Will the proposed rule create any unnecessary obstacles to the foreign commerce of the United States -- i.e., create barriers to international trade? ***[This question relates to the Trade Agreement Act of 1979.]***

No. This will be a harmonized rule between the FAA and JAA, and will be recognized by other certification agencies as well.

(4) Will the proposed rule result in spending by State, local, or tribal governments, or by the private sector, that will be $100 million or more in one year? ***[This question relates to the Unfunded Mandates Reform Act of 1995.]***

No.

4. ADVISORY MATERIAL

a. Is existing FAA or JAA advisory material adequate? Is the existing FAA and JAA advisory material harmonized?

No, the existing advisory material is made obsolete by this rule change. Yes, the Working Group developed a proposed new harmonized advisory circular.

b. If not, what advisory material should be adopted? Should the existing material be revised, or should new material be provided?

New advisory material has been developed to provide an acceptable means of compliance to the new rule.

c. Insert the text of the proposed advisory material here (or attach), or summarize the information it will contain, and indicate what form it will be in (e.g., Advisory Circular, Advisory Circular – Joint, policy statement, FAA Order, etc.)

The proposed draft of AC/ACJ 25.1329-1x is attached to this report.